

DEFENSE THREAT REDUCTION AGENCY
14.B Small Business Technology Transfer (STTR)
Proposal Submission Instructions

The approved FY14.B topics solicited for in the Defense Threat Reduction Agency (DTRA) Small Business Technology Transfer (STTR) Program are listed below. Offerors responding to this Solicitation must follow all general instructions provided in the Department of Defense (DoD) Program Solicitation. Specific DTRA requirements that add to or deviate from the DoD Program Solicitation instructions are provided below with references to the appropriate section of the DoD Solicitation.

The DTRA STTR Program addresses development of innovative ideas against DTRA's mission to counter Weapons of Mass Destruction (Chemical, Biological, Radiological and Nuclear) threats and that are consistent with the purpose of the STTR Program – i.e., to stimulate a partnership of ideas and technologies between innovative small business concerns (SBCs) and research institutions through Federally-funded R/R&D to addresses DTRA needs.

For technical questions about specific topics during the Pre-Solicitation period (21 August 2014 to 21 September 2014), contact the DTRA Technical Point of Contact (TPOC) for specific topic. To obtain answers to technical questions during the formal Solicitation period, visit <http://www.dodsbir.net/sitis>. For general inquiries or problems with the electronic submission, contact the DoD Help Desk at 1-866-724-7457 (8:00 am to 5:00 pm EST). Specific questions pertaining to the DTRA STTR Program should be submitted to:

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PHASE I PROPOSAL GUIDELINES

The TPOC leads the evaluation process of all proposals submitted for their topics. In this process, DTRA will make a determination as to whether the proposal is relevant to the topic solicited. Only relevant proposals will be evaluated against further criteria. DTRA will evaluate Phase I proposals using the criteria specified in section 6.0 of the DoD STTR Program Solicitation during the review and evaluation process. The criteria will be in descending order of importance with technical merit being the most important, followed by qualifications, and followed by the commercialization potential. With other factors being equal, cost of the proposal may be included in the evaluation. DTRA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded. Phase I contracts are limited to a maximum of \$150,000 and seven months of performance. DTRA anticipates funding one or possibly two STTR Phase I contracts to small businesses with their research institution partner for each topic.

The DoD SBIR/STTR Proposal Submission system (<http://www.dodsbir.net/submission/>) provides instruction and a tutorial for preparation and submission of your proposal. Refer to section 5.0 at the front of this solicitation for detailed instructions and the Phase I proposal format. You must include a Company Commercialization Report (CCR) as part of each proposal you submit. If you have not updated your commercialization information in the past year, or need to review a copy of your report, visit the DoD SBIR/STTR Proposal Submission site. Please note that improper handling of the

Commercialization Report may have a direct impact on the review and evaluation of the proposal (refer to section 5.4.e of the DoD Solicitation).

Proposals addressing the topics will be accepted for consideration if received no later than the specified closing hour and date in the solicitation – **6:00 a.m. ET, Wednesday, 22 October 2014**. The Agency requires your entire proposal to be submitted electronically through the DoD SBIR/STTR Proposal Submission Web site (<http://www.dodsbir.net/>). A hardcopy is NOT required and will not be accepted. Hand or electronic signature on the proposal is also NOT required.

DTRA has established a **20-page limitation** for Technical Volumes submitted in response to its topics. This does not include the Proposal Cover Sheets (pages 1 and 2, added electronically by the DoD submission site), the Cost Volume, or the Company Commercialization Report. The Technical Volume includes, but is not limited to: table of contents, pages left blank, references and letters of support, appendices, key personnel biographical information, and all attachments. DTRA requires that small businesses complete the Cost Volume form on the DoD Submission site versus submitting it within the body of the uploaded volume. Proposals are required to be submitted in Portable Document Format (PDF), and it is the responsibility of submitters to ensure any PDF conversion is accurate and does not cause the Technical Volume portion of the proposal to exceed the 20-page limit. **Any pages submitted beyond the 20-page limit, will not be read or evaluated.** If you experience problems uploading a proposal, call the DoD Help Desk 1-866-724-7457 (8:00 am to 5:00 pm ET).

Companies should plan carefully for research involving animal or human subjects, biological agents, etc. (see sections 4.7 - 4.9). The few months available for a Phase I effort may preclude plans including these elements, unless coordinated before a contract is awarded.

If the offeror proposes to use a foreign national(s) – refer to sections 3.5 and 5.4.c(8) in the DoD Solicitation for definitions and reporting requirements. Please ensure no Privacy Act information is included in this submittal.

If a small business concern receives an STTR award they must negotiate a written agreement between the small business and their selected research institution that allocates intellectual property rights and rights to carry out follow-on research, development, or commercialization (section 10).

PHASE II PROPOSAL GUIDELINES

Small business concerns awarded a Phase I contract will be permitted to submit a Phase II proposal for evaluation and potential award selection. The Phase II proposals must be submitted NLT 30 days BEFORE the end of the Phase I effort.

All STTR Phase II awards made on topics from solicitations prior to FY 13 will be conducted in accordance with the procedures specified in those solicitations.

DTRA is not responsible for any money expended by the proposer prior to contract award.

This is the first year for the DTRA STTR Program so any Phase II awards would need to result as a follow-on to SBIR or STTR Phase I completions for other DoD organizations. All Phase I awardees may apply for a Phase II award for their topic.

Phase II proposals will be reviewed for overall merit based upon the criteria in section 8.0 of this solicitation and will be similar to the Phase I process. The TPOC leads the evaluation process of all proposals submitted in their topics. DTRA will evaluate Phase II proposals using the criteria specified in

section 8.0 of the DoD STTR Program Solicitation during the review and evaluation process. The criteria will be in descending order of importance with technical merit being the most important, followed by contractor's qualifications, and followed by the commercialization potential. With other factors being equal, cost of the proposal may be included in the evaluation. DTRA reserves the right to limit awards under any topic and only proposals considered to be of superior quality will be funded.

STTR Phase II proposals have 4 sections: Proposal Cover Sheet, Technical Volume, Cost Volume and Company Commercialization Report. As instructed in section 5.4.e of the DoD STTR Program Solicitation, the CCR is generated by the submission website based on information provided by you through the "Company Commercialization Report" tool.

PUBLIC RELEASE OF AWARD INFORMATION

If your proposal is selected for award, the technical abstract and discussion of anticipated benefits will be publicly released via the Internet. Therefore, do not include proprietary or classified information in these sections. For examples of past publicly released DoD SBIR/STTR Phase I and II awards, visit <http://www.dodsbir.net/awards>.

TECHNICAL ASSISTANCE

In accordance with the Small Business Act (15 U.S.C. 632), DTRA will authorize the recipient of a Phase I STTR award to purchase technical assistance services, such as access to a network of scientists and engineers engaged in a wide range of technologies, or access to technical and business literature available through on-line data bases, for the purpose of assisting such concerns as:

- making better technical decisions concerning such projects;
- solving technical problems which arise during the conduct of such projects;
- minimizing technical risks associated with such projects; and
- developing and commercializing new commercial products and processes resulting from such projects.

If you are interested in proposing use of a vendor for technical assistance, you must provide a cost breakdown in the Cost Volume under "Other Direct Costs (ODCs)" and provide a one-page description of the vendor you will use and the technical assistance you will receive. The proposed amount may not exceed \$5,000 and the description should be included as the LAST page of the Technical Volume. This description will not count against the 20-page limit and will NOT be evaluated. Approval of technical assistance is not guaranteed and is subject to review of the contracting officer.

DECISION AND NOTIFICATION

DTRA has a single Evaluation Authority (EA) for all proposals received under this solicitation. The EA either selects or rejects Phase I and Phase II proposals based upon the results of the review and evaluation process plus other considerations including limitation of funds, and investment balance across all the DTRA topics in the solicitation. To provide this balance, a lower rated proposal in one topic could be selected over a higher rated proposal in a different topic. DTRA reserves the right to select all, some, or none of the proposals in a particular topic.

Following the EA decision, DTRA STTR will release notification e-mails for each accepted or rejected offer. E-mails will be sent to the addresses provided for the Principal Investigator and Corporate Official.

Offerors may request a debriefing of the evaluation of their not selected proposal and should submit this request via email to dtrasbir@dra.mil and include "STTR 14.B Topic XX Debriefing Request" in the subject line. Debriefings are provided to help improve the offeror's potential response to future solicitations. Debriefings do not represent an opportunity to revise or rebut the EA decision.

For selected offers, DTRA will initiate contracting actions which, if successfully completed, will result in contract award. DTRA Phase I awards are issued as fixed-price purchase orders with a maximum period of performance of seven-months. DTRA may complete Phase I awards without additional negotiations by the contracting officer or opportunity for revision for proposals that are reasonable and complete.

DTRA STTR 14.B Topic Index

DTRA14B-001	Production of Chemical Reagents for Prompt-Agent-Defeat Weapons
DTRA14B-002	Production of Inactivated Virus Vaccines Using Supralethal Irradiation
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DTRA14B-005	Large-area, High-efficiency, Light-weight Portable Neutron Detector

DTRA STTR 14.B Topic Descriptions

DTRA14B-001

TITLE: Production of Chemical Reagents for Prompt-Agent-Defeat Weapons

TECHNOLOGY AREAS: Chemical/Bio Defense, Materials/Processes

OBJECTIVE: The objectives of this effort are to: 1) develop the necessary manufacturing processes to produce kilogram quantities of novel halogen-containing chemical reagents, and 2) to apply these processes to manufacture several kilograms of these reagents. These novel chemical reagents have been previously researched for use to reliably destroy biological-agent targets that could pose a threat to global security.

DESCRIPTION: The Defense Threat Reduction Agency's Basic Research Program, Thrust Area 4 – Science to Defeat WMD (weapons of mass destruction), has been supporting research of energetic materials and incendiaries as payloads for weapons to defeat targets containing chemical and biological agents. Several universities and Navy labs have been involved in this research, and have narrowed down on a few material formulations that are efficient biocides. These formulations contain a chemical ingredient H3IO8, which is currently commercially obtained as HIO3 and processed at gram-scales in a Navy lab. While the process path is not complicated, larger-scale production at a Navy lab is not cost beneficial nor process efficient for larger scale needs. Therefore, we are seeking to scale-up processing to inexpensively produce H3IO8 to support larger-scale testing and evaluation of future agent-defeat weapons. The success of this work will result in capabilities to deny enemy use of bio-agents while mitigating the associated collateral damage and effects of an infectious downwind plume.

PHASE I: 1) Develop cost-beneficial manufacturing processes for producing kilogram quantities of H3IO8 with high purity (99.5%) and small particle size (about 2 microns). 2) Produce 500 to 1000 grams quantities of H3IO8 as needed for test articles. 3) Ship material for performance testing.

PHASE II: Based on the quality of H3IO8 produced in Phase I, the cost/benefits of H3IO8 production, the likely hood of successfully scaling up to kg amounts, and the performance of the material formulations for bio-agent defeat; DTRA will decide a path forward for Phase II. Phase II work will be to produce larger scale quantities (5 to 20 kilogram) of H3IO8 with the same purity and particle size standards described in the Phase I effort. Material produced in Phase II will be used for larger scale testing. Development of a commercialization strategy should also be achieved in Phase II.

PHASE III: DUAL USE APPLICATIONS: H3IO8 is a dual use chemical that has potential to be used not only in WMD-defeat weapons but also in propellant systems.

REFERENCES:

1. Defense Threat Reduction Agency Broad Agency Announcement HDTRA1-08-10-BRCWMD-Service Call, Topic Per5-H: Bio-Agent Defeat (Thrust 4), June 2010, <http://www.dtra.mil/documents/research/BRCALL08-10.pdf>.
2. Efficacy of Energetic Formulations in the Defeat of Bio Agents, https://www.combustioninstitute.org/upload_resources/12S-86.pdf
3. Thermobaric materials and devices for chemical/biological agent defeat, US 8118955 B2, April 2007, <http://www.google.com/patents/US8118955>.

KEYWORDS: chemicals, chemical processing, chemical production, iodine

DTRA14B-002

TITLE: Production of Inactivated Virus Vaccines Using Supraethal Irradiation

TECHNOLOGY AREAS: Biomedical, Human Systems

OBJECTIVE: Develop a rapid, scalable, and cost-effective method for production of inactivated virus vaccines

DESCRIPTION: The Defense Threat Reduction Agency's Chemical-Biological Technologies (CB) program is charged with discovery and development of Medical Countermeasures, including vaccines, against priority biological threats. Classical methods of vaccine production use either modified live ("attenuated") virus or killed ("inactivated") virus to stimulate immunity. Production of safer and more stable killed virus vaccines is desirable for combatting highly virulent pathogens like those of interest to CB. However, standard methods of inactivation tend to reduce vaccine efficacy by damaging surface epitopes necessary for actuating immunogenic responses and conferring immunity. Developing a means to fully inactivate virus while maintaining the structural integrity of viral epitopes has proved challenging.

Recent work demonstrates that metal-peptide complexes isolated from the radiation-resistant bacterium *Deinococcus radiodurans* can protect against radiation insult by keeping vital cellular proteins intact. The researchers speculate the discovery could lead to a new method for virus inactivation that uses supralethal doses of radiation to ensure complete degradation of the viral genome while protecting the surface epitopes. Application of the technique resulted in the development of a vaccine for Venezuelan Equine Encephalitis (VEE) virus which preliminary studies show is both safe and effective. The research demonstrates the potential for using supralethal irradiation as a "next generation" method of inactivation to produce vaccines for dangerous pathogens. The present topic focuses on using supralethal irradiation to develop inactivated whole organism vaccines in a rapid, scalable, and cost-effective fashion.

PHASE I: Define the component technologies needed to develop an inactivated virus vaccine using supralethal irradiation. The preliminary focus should be on a model viral pathogen for which immunological response is well-characterized (e.g., polio, influenza). Describe the tradespace, or "manufacturing space", for vaccine development and indicate the advantage conferred by the method proposed. Demonstrate cognizance of requirements for statistical process control. Develop an FDA regulatory approval plan for any vaccines developed. Determine the radiation dose required to fully inactivate the virus and evaluate the impact of inactivation on antigenicity using in vitro screening methods. The Phase I deliverable is a report detailing (1) advantages and disadvantages/limitations of proposed method with respect to safety, efficacy, production, and cost, (2) preliminary in vitro data, and (3) FDA regulatory approval plan.

PHASE II: Iteratively refine the method, as needed, and validate with in vitro testing. Produce the selected vaccine in batches of sufficient size to support small animal testing. Evaluate immunogenicity of the vaccine relative to formalin, other chemical, or heat-based inactivation in a small animal model. Conduct preliminary safety and efficacy tests in a small animal model. Design-of-experiments should consider appropriate sample sizes to support meaningful statistical analysis and lay the foundation for additional testing. Demonstrate feasibility of scale-up using Good Manufacturing Processes (GMP). Consider feasibility of extending the method to production of vaccines for pathogens of interest (e.g., alphaviruses, filoviruses) to the Chemical and Biological Defense Program (CBDP). The Phase II deliverable is a report detailing (1) description of vaccine production method, including optimization techniques and outcomes, (2) testing and validation data, (3) plan for regulatory approval, and (4) advantages and disadvantages/limitation of method with respect to safety, efficacy, production, and cost for vaccines relevant to CBDP requirements/needs.

PHASE III: Comprehensively evaluate safety and efficacy of the vaccine in a small animal model and transition to pharmaceutical manufacturing company. An appropriately detailed plan for meeting FDA licensure requirements will be in place. Additional testing to meet those requirements will be conducted. A plan to evaluate utility of the method for developing vaccines relevant to CBDP will be provided. Because the method is potentially applicable to a broad range of pathogens, it is inherently dual use and will benefit military as well as civilian populations. Although additional funding may be provided through DoD sources, the awardee should look to other public or private sector funding sources for assistance with transition and commercialization.

REFERENCES:

1. Babb R et al. 2014. Gamma-irradiated influenza A virus provides adjuvant activity to a co-administered poorly immunogenic SFV vaccine in mice. *Frontiers Immunol* 5:1-7.
2. Daly MJ. 2012. Death by protein damage in irradiated cell. *DNA Repair* 11:12-21.

3. Delrue I, Verzele D, Madder A, Nauwynck HJ. 2012. Inactivated virus vaccines from chemistry to prophylaxis: merits, risks, and challenges. *Expert Rev Vaccines* 11:695-719.
4. Gaidamakova E et al. 2012. Preserving immunogenicity of lethally irradiated viral and bacterial vaccine epitopes using a radio-protective Mn²⁺-peptide complex from *Deinococcus*. *Cell Host Microbe* 12:117-124.
5. Rappuoli R, Black S, Lambert PH. 2011. Vaccine discovery and translation of new vaccine technology. *Lancet* 378:360-368.

KEYWORDS: vaccine, inactivated virus, biological agents, supralethal irradiation, medical countermeasures

DTRA14B-003

TITLE: Network Analytics for High Consequence Events

TECHNOLOGY AREAS: Information Systems, Human Systems

OBJECTIVE: The objectives of this effort are to: 1) develop a software based, open source, extendable, dynamic topology network simulator that models and analyzes dynamic information structures and exchanges across different layers over large time régimes for both direct and cascading failures to identify cost-effective solutions for enhanced physical network robustness and recovery response time, and/or 2) develop a course-of-action analysis tool to identify methods for reducing incentives of state and non-state actors to pursue, possess, and employ WMD, and/or 3) analyze text to populate a knowledge base to support activity based queries as well as activity level analysis including patterns, trends, and anomalies.

DESCRIPTION: The Defense Threat Reduction Agency's Basic Research Program, Thrust Area 2 – Network Sciences has been supporting research to: 1) model and analyze dynamic network-based information to recognize and control cascading failure over large geographic areas across multi-layered networks (telecomm, SCADA, power, gas, transportation, social...) that have a time dependent topology.^{1,2} In parallel, there has been supported research on 2) motivations and intent to acquire and use Weapons of Mass Destruction (WMD) utilizing social network theory, behavior modelling and information processing.^{1,2} Several universities and National and Military labs have been involved in this research, and have developed partial solution algorithms or theories to both challenges, but are not in a form useable by operational support teams that must assess vulnerability, impact and risk, and then plan strategic mitigation. Additionally, 3) DTRA is funding work in Deep NLP using grammar (that supposed semantic components and linguistic constructions such as Head-driven Phrase Structured Grammar, and also Embodied Construction Grammar, or Combinatory Categorical Grammar) to combine the result of semantic role labeling/frame analysis with semantic parsing. This combination of information provides a knowledge structure that will facilitate a full spectrum of knowledge base related analysis (anomalies, alerts, query response, etc.).

Therefore, we are seeking to package/codify theories and algorithms into tools for operational use. The success of this work will result in capabilities to identify cost effective solutions to 1) model/control geographically large damage to physical networks, and/or 2) course-of-action analysis to reduce incentives to pursue, possess, and employ WMD, and/or 3) NLP to identify WMD-related information from text.

PHASE I: Develop a software performance specification (SPS) with the associated Interface Design Description (IDD) and Software Design Description (SDD) for the end-state tool as applicable to one of the topic objectives

PHASE II: Based on approval of the Phase I deliverables, Phase II work will be to produce a prototype analysis tool. Development of a commercialization strategy should also be achieved in phase II.

PHASE III: DUAL USE APPLICATIONS: Both types of tools are dual use in that they have to potential to be used for 1) large sized disasters (e.g., hurricanes or earthquakes), 2) and/or for business management tools in different cultural markets, and/or 3) social media.

REFERENCES:

1. Defense Threat Reduction Agency Broad Agency Announcement HDTRA1-11-16-BRCWMD-BAA
2. Defense Threat Reduction Agency Broad Agency Announcement HDTRA1-08-10-BRCWMD-BAA

KEYWORDS: network, social/behavioral models, cultural factors, natural language processing, semantic analysis, analytics, power flow, control, mitigation strategy, data fusion, dynamics, emergent threat, course-of-action analysis

DTRA14B-004

TITLE: Widely Distributable Nano/Micro-scale Radiation Sensor

TECHNOLOGY AREAS: Materials/Processes, Sensors, Electronics

OBJECTIVE: Design and develop a device based on a nano-sensing material that can be deployed across a large area and large variety of environments to detect sources of gamma, alpha, and beta radiation.

DESCRIPTION: The DTRA Basic Research Program supports expanding knowledge of the basic science of sensors useful for locating radioactive materials, finding nuclear weapons, and detecting and characterizing facilities associated with WMD. Nanoscience can be used to better tailor the interactions between radiation and materials for improved detection. Nanoscale materials that respond in the presence of ionizing radiation, and which can be incorporated in other widely used materials or objects, would be useful for locating and securing radiological or nuclear materials. A goal is to be able to deploy such material without the need to simultaneously deploy sets of entire detector systems. It is desirable to maximize the detection area while being cost efficient.

It would be useful to have indicators of the presence of several types of radiation, including alpha, beta, and gamma. There has been recent progress in nano and micro scale detection of radioactive material. It is desirable to use these novel detectors to find radioactive materials with total doses less than 1 Gy. The type of radiation detectable by proposed novel indicators should be described. Multiple radiation signatures are desirable but not required.

In order to support a reliable network to detect the presence of ionizing radiation, the research and development team must provide a means of confirming use under several criteria. General performance criteria to be addressed include: easy deployment; weight; cost; sensitivity thresholds (specify energy windows); lower limit of radiation dose sensitivity; and ability to read output with Current Off-the Shelf (COTS) equipment.

PHASE I: 1) Identify and define potential nano-scale or micro-scale materials and component design for gamma radiation sensors by collaboration between small business and university. 2) Evaluate feasibility of selected nano- or micro-scale material. 3) Provide a path forward for prototype design sensing material, test, evaluation, and fabrication.

PHASE II: Develop, demonstrate, and validate these prototype components for their utility according to performance criteria. Develop a production-scalable process and business plan to manufacture the sensors.

PHASE III: DUAL USE APPLICATIONS: Successful product will support Military and Commercial sensor applications. This may include a path toward civilian use for contamination characterization to support environmental applications.

REFERENCES:

1. Nanotechnology-Enabled Energy Harvesting for Self-Powered Micro-/Nanosystems, Agewandte Chemie, Volume 51, Issue 47, November 2012.
2. Novel Micro/Nano Approaches for Radiation Sensors and Materials, SPIE Proceedings, Volume 8373, Baltimore, Maryland, April 2012.

KEYWORDS: Radiation, microelectronics, nanotechnology, sensors

TECHNOLOGY AREAS: Sensors, Battlespace, Nuclear Technology

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 3.4 of the solicitation.

OBJECTIVE: Develop a light-weight, large-area, high efficiency, portable ^3He neutron detector alternative detector for passive interrogation for homeland and defense security applications. Electronics are resistant to microphonics, vibration, and shock and capable of filtering the same from the detector. An optional gamma-ray sensitive radioisotope identification system must be included to eliminate NORMs. The detector must have reach back or GPS capabilities. Cost of the proposed neutron detectors should be 50% less than current ^3He tubes.

DESCRIPTION: DTRA has supported DoD's nuclear neutron detection community by: 1) developing models for optimizing performance of large-area high-efficiency multi-wire proportional counters (MWPC); 2) developing methods of producing low cost MWPC's. These research activities have given the DoD the ability to produce large-area high-efficiency MWPCs for passive interrogation efforts.

There is currently a need for lightweight, rugged, high-efficiency neutron detectors. The threat of a nuclear attack has only increased since 9/11, a detector is required that can be deployed with warfighters and inspectors. To date there is not a portable neutron detector capable of covering a large area with high detection efficiency while maintaining ruggedness and low cost that does not contain ^3He gas. The area of investigation will focus on the development of a large-area, high-efficiency, rugged, portable, light-weight (10 kg (22.04 lbs.)) dual neutron and gamma-ray spectrometer. In some cases, gamma-ray energy identification may be critical, thus it is necessary to include an optional detector that also offers radioisotope identification. In the past, DTRA has shown interest in the use of a portable (i.e. backpack) neutron detectors for passive interrogation applications.

This detector would be capable of being used by a soldier anywhere in the field. In order to locate a SNM rapidly, size and efficiency are crucial aspects of the detector. Many detectors offer high intrinsic efficiency, but cover at most a few square centimeters of area, thereby requiring a soldier to be close to the interrogated radiation source for identification and location. Alternatively, some detectors are large in area, but low in efficiency and a soldier must again be relatively close to a source in order to know of its presence. Thus, there is a need for a detector capable of both high efficiency and large effective-area while remaining light weight.

Soldiers may use the detectors in the field/area of a nuclear accident, such as the incident in Fukushima, Japan, or in the immediate emergency need to locate a SNM that has been tipped by intelligence or other warnings. An additional application of the detector is the search for nuclear weapons and materials in foreign countries. For example, Iran has interest in developing a nuclear power plant along with centrifuges for uranium enrichment. The U.S. has shown publicly that they do not want Iran to have access to nuclear materials. This detector could easily be deployed to soldiers or inspectors to ensure that Iran is meeting the international requirements. Other applications include emergency response, law enforcement, border/portal security, HAZMAT, radiation safety, passenger monitoring, port and freight monitoring, and non-proliferation enforcement.

The detector's ability to locate SNM's should exceed performance of presently available backpack/portable systems, even those systems still using ^3He proportional counters. The associated electronics of the detector would be developed such that an alarm would sound when the radiation level increased above a predetermined threshold level. A reach back system would also be incorporated into the system with GPS location options.

PHASE I: Complete simulations of the proposed portable/backpack detector with a thermal intrinsic detection efficiency of $\geq 50\%$ or greater, a minimum gamma-ray rejection ratio of 10^{-7} , cover a minimum neutron sensitive effective area of approximately to 625 cm², and fit within a 10 kg (22.04 lbs.) weight limit. A proof-of-principle prototype should be constructed to support model validation. The proposers should present an approach based on the

modeling results and prototype results that show the proposed detector can be built meeting all above mentioned requirements.

PHASE II: Build a full-scale prototype including electronics and incorporating the detector, battery pack, and electronics into a backpack. Test the portable/backpack detector for microphonics, vibration, and shock defined by the current ANSI standards and pass. The detector system must meet the gamma-ray and neutron sensitivity requirements set by the ANSI standards and the above mentioned requirements. Another version of the detector will also be fully developed that includes a gamma-ray sensitive detector for radioisotope identification. Paths for mass production and cost projections will be calculated. Methods for lowering power consumption and other options for user friendly GUI interface are being developed, such as Bluetooth or iridium satellite communication for reachback capability and GPS location options.

PHASE III: Team with a National Laboratory or commercial partner to develop a commercial search instrument for military applications of interest to DTRA as well as domestic applications in the Secure the Cities Initiative or the overall Global Nuclear Detection Architecture and other DHS, State, and/or local security applications. Separate teaming with commercial companies should be explored in development of more sophisticated dosimetry measuring devices for both military and civilian use.

REFERENCES:

1. McGregor, D.S., M.D. Hammig, H.K. Gersch, Y-H. Yang, and R.T. Klann, "Design Considerations for Thin Film Coated Semiconductor Thermal Neutron Detectors, Part I: Basics Regarding Alpha Particle Emitting Neutron Reactive Films," Nuclear Instruments and Methods, A500 (2003) pp. 272 – 308.
2. K.A. Nelson, M.R. Kusner, B.W. Montag, M.R. Mayhugh, A.J. Schmidt, C.D. Wayant, J.K. Shultis, D.S. McGregor, "Characterization of a Mid-Sized Li Foil Multi-Wire Proportional Counter Neutron Detector," Nucl. Instrum. and Meth., A762 (2014) pp. 119-124.
3. K.A. Nelson, S.L. Bellinger, B.W. Montag, J.L. Neihart, T.A. Riedel, A.J. Schmidt, D.S. McGregor, "Investigation of a Lithium Foil Multi-Wire Proportional Counter for Potential ^3He replacement," Nucl. Instrum. and Meth., A 669 (2012) pp. 79-84.
4. K.A. Nelson, B.W. Montag, A.J. Schmidt, C.D. Wayant, D.S. McGregor, "A layered ^6Li multi-wire proportional counter," IEEE Conf. Proceedings NSS/MIC, N5-3, pp. 597-599, 2012.
5. K.A. Nelson, S.L. Bellinger, B.W. Montag, J.L. Neihart, T.A. Riedel, A.J. Schmidt, D.S. McGregor, Member, "Investigation of Aerogel, Saturated Foam, and Foil for Thermal Neutron Detection," IEEE Nuclear Science Symposium, Valencia, Spain, Oct. 23-29, 2011.
6. J.L. Lacy, A. Athanasiades, C. S. Martin, L. Sun, and G. J. Vazquez-Flores, "Fabrication and Performance of Corrugated Boron-Coated Straw Neutron Detector," IEEE Nuclear Science Symposium, Seoul, Korea, Oct. 25-Nov. 2, 2013.

KEYWORDS: Passive neutron interrogation, portable/backpack, high-efficiency